

Ceres and Pluto: Dwarf Planets as a New Way of Thinking about an Old Solar System

Developer: John Ristvey, McREL

Audience: Grades 5-8

Format: Website/PDF

Panel Recommendation: *Medium Revisions*

While the panel liked the approach of the product, they felt the execution was incomplete. They determined that the following revisions are needed before the product is resubmitted:

- Define/explain the ‘NASA photo exchange.’
- The IAU does not define ‘what a planet is.’
- Instructions describe six steps, but there are only five.
- One reviewer identified twelve scientific content issues that need to be addressed (these are included in the summary and individual review reports below).
- Add student assessments.

Individual Review Summary (prior to panel telecon)

Following is the summary of the individual reviews that was distributed to the reviewers prior to the panel discussion by telecon. This information was used to guide the panel discussion; it is included here to provide a complete report of the review process.

Reviewer	Overall Rating	Recommendation
Education Reviewer	Fair	Major Revisions
Education Reviewer	Good	Recommended
Education Reviewer	Very Good	Recommended
Science Reviewer	Very Good	Recommended, revisions next update
Science Reviewer	Good	Minor Revisions
Science Reviewer	Very Good	Minor Revisions

Strengths:

- National science standards and language arts standards were addressed and bridged effectively (though one reviewer felt that the product did not satisfy them completely enough).
- The content is error free.
- The introduction of science content to language development curricula is valuable and is executed well by this product.
- It is well written and designed.
- Students make observations and create classification criteria.
- Planetary classifications and the properties of planets are discussed making this product relevant to NASA SMD space science education.

- The materials are appropriate for the target audience.
- Scientific vocabulary is introduced and defined.
- There are a number of Websites listed for additional information and investigations (though some reviewers felt they may be more appropriate for teachers than the target audience).

Weakness	Response
Define/explain the ‘NASA photo exchange.’	We have included a link and explanation to the NASA Image exchange in the Teacher Resource Section.
The product did not require investigative skills or analysis skills to complete. It did not nurture scientific reasoning via these instructional practices.	True, however, this activities was not intended to require investigation skills or analysis. The science inquiry standard that we aligned with is to help students “understand about scientific inquiry.” In this case the focus is on student understanding of inquiry not the skills necessary to do inquiry. Both are included in the NSES.
The product did not present opportunities to develop fundamental understandings of key scientific concepts, principles, theories or laws. Definitions alone were explored.	We disagree. The goal of the activity was to help students develop a better understanding of what a planet is and how definitions change as we collect new data (e.g., objects in Kuiper belt). This is a fundamental scientific concept as indicated in the middle school standards: <i>The earth is the third planet from the sun in a system that includes the moon, the sun, eight¹ other planets and their moons, and smaller objects, such as asteroids and comets.</i>
There are no student assessments included (though teachers may evaluate students based on the Venn diagram and matrix).	The intent was that the Venn Diagram and Comparison Matrix be used as an assessment. Added pre and post assessment exercise.
One reviewer felt that the overall approach, organization and presentation of the materials makes this product difficult to use.	Added student activity sheet.
One reviewer found the wording in the second sentence of the first paragraph awkward. This reviewer also had trouble transitioning from the Venn diagram to the matrix discussion. Suggest adding ‘see	Wording changed to: <i>The IAU’s decision has not changed the structure of the solar system; it has merely presented a different way of classifying the bodies that make it up.</i>

¹ With the IAU’s new nomenclature there are now seven other planets

sample activities that follow' to the step 4 description to link the description to the activities. Also link the comparison matrix to the term comparisons (the Venn diagram).	Added sample activities. Added linkages with text.
One reviewer was concerned about the use of Wikipedia as a source (even with the stated disclaimer).	Shall we take this out? Or provide a rationale here?
Page 1: The product implies the IAU has always had a definition for 'what a planet is.' The IAU probably did not have an official definition so they were defining it for the first time based on new discoveries. Suggest rewording the sentence with "new definitions of planet and dwarf planet" as the term dwarf planet did not exist prior to Pluto's reclassification.	Removed "redefined."
Page 1: Clarify the phrase "Solar System "made up" of empty space."	Changed the wording: <i>Many of us have grown up with an understanding that our solar system is comprised of remnants from its early formation 4.5 billion years ago, primarily: bodies such as the Sun, planets, asteroids and comets; gas and dust, as well as a large volume of space.</i>
Page 1: Suggest saying something about what the asteroid belt is and where it is (it is a concept many college students do not know or remember). If one is going to say that Ceres got "demoted," when did that happen? It happened 150 years ago.	Added parenthetical definition of "asteroid belt." Added " <i>about 150 years ago.</i> "
Page 1: It is not only discoveries that make us change how we see things, it is also the evolution of our knowledge that changes over time . For example, the size of Pluto or in the case of the reclassification of Pluto. It was in part due to new models for the formation and evolution of the solar system since the original definition was primarily one based on dynamics and not on physical properties).	One might say that these examples are in fact discoveries. We added: " <i>and our changing understanding over time</i> "
Page 2: Language arts. Why is the same item listed twice? Is this correct?	Deleted duplicate

Page 2: Instructions mention 6 steps but page 4 only lists 5 steps.	Direction for step six was added.
Page 3: State the origin of the definition of an asteroid. Was this after the IAU meeting? It was not part of the original voting at the meeting.	Added: <i>“The following is a definition of the word asteroid which was not defined by the IAU, but falls within its definition of small solar system bodies. In the early 1800’s the term asteroid was used to describe Ceres and Pallas because of their small “starlike” appearance when observed in the night sky.”</i>
Page 3: The image of the asteroid belt is misleading. It was not taken by the HST though it may have been provided by the Space Telescope Institute. This could easily lead to misconceptions.	This has been fixed.
<p>Page 3 and 4: Contain good images of Ceres and Vesta. However, who actually created the images? They may have come from a JPL or NASA website, but you must give credit to the groups who created them.</p> <p>Pages 5 and 6: There are problems with many of the images. The planets are not round. Without the context of where these objects are, one could also show large moons and readers would not be able to tell them apart from planets.</p> <p>Why show the image of Pluto the way it is? Is this showing that it has not cleared its space of smaller bodies? One could do the same with the Galileo image of the Earth and Moon.</p> <p>There are better images that show more details and a round Pluto. Without a scale, the student has no idea how big any of these objects are.</p> <p>The last image shows the Kuiper Belt and I assume three KBOs, but the label mentions comets. No objects are actually shown. In</p>	<p>These are the correct citations.</p> <p>Included information about whether the body has cleared its neighborhood or not.</p> <p>Pluto is a dwarf planet, Charon is a satellite.</p> <p>In this case, size does not matter.</p> <p>Added a label to clarify what the Kuiper belt is and that students should classify a KBO.</p>

this section, the Kuiper Belt is still not defined.	
Page 8: Contains wonderful references, but these are not meant for middle/high school.	Now found in TG only.
Page 8 (Table): This is a good table, but much of this information is never discussed in any of the accompanying material. The material can be found in the references, but the topics should have been discussed as part of this packet.	We intended for this table to be ancillary to the main activity and provide the teacher with information that can be used for discussion. It was designed as an independent project. We will include an answer key, but incorporating discussion about each of these content areas is beyond the scope of this activity.
One reviewer felt that this method of studying vocabulary might not be as new as advertised in the title.	The title does not “advertise” the strategy as being new. It does state that Dwarf planets are a new way of thinking about an old solar system.
Suggest clearly stating the target audience in the materials.	Added that this activity is intended for middle school in paragraph one.
Suggest adding teacher notes and/or answer sheets to complete the materials. One reviewer felt that the product is not complete without expanded teacher notes and answer sheets.	We added an answer sheet for the comparison matrix.
One reviewer noted that the product seemed to imply that the IAU defined planets before the Pluto debate, which is not the case. Suggest covering how the term planet came into common usage.	Added this to the first paragraph.